35 centavos a copy
₱3.00 a year
(10 numbers)

The Philippine Agriculturist

Foreign subscription
$2.00 a year
(U. S. currency)

Entered at the Post-Office at Los Baños, Laguna, as second-class mail-matter

EDITORS

Sam F. Trelease, Ph.D.
Associate Professor of Plant Physiology

Emma S. Yule, B.D.
Assistant Professor of English

BUSINESS MANAGER
Nemesio B. Mendiola, Ph.D.
Assistant Professor of Agronomy

ASSISTANT BUSINESS MANAGER
Toribio Vibar, B.Agr.
Instructor in Agronomy

BOARD OF CONTROL

Charles F. Baker, M.A.
Dean, College of Agriculture

Forman T. McLean, Ph.D.
Associate Professor of Plant Physiology

Manuel L. Roxas, Ph.D.
Associate Professor of Chemistry

Evett D. Hester, A.B.
Associate Professor of Economics

Bienvenido Ma. Gonzalez, M.S.
Associate Professor of Animal Husbandry

AUDITOR EX-OFFICIO
Elias Manalang
Property Officer, College of Agriculture

VOL. VIII OCTOBER, 1919 NO. 3.

MAN POWER

The successful operation of an educational institution depends upon the character and qualifications of its teaching force. Likewise, the nature and amount of work done by any governmental entity or any business is determined by the character of the personnel in control. Doubly important does this matter of *man power* become in a new country where everything must be in a state of rapid evolution, and where the planning and operating of developmental projects under new and more or less unique conditions require a very different type of mind and of training from that needed in the mechanical carrying out of established method.

The most vital function of a new country must be the production of trained men from the ranks of its own people. No new country can safely continue to conduct its education, its business, and its industries by means of foreign experts. Japan awoke to the realization of this fact forty or fifty years ago. And, in addition to the establishment of a great national university and college of agriculture, she sent hundreds of students abroad to study not only technical and professional work, but all lines of industrial work and business administration as well. As a result of this policy, Japan has accomplished one of the wonders of modern times in racial and national development. Also, the far-sighted men of China have long been fully aware of the same necessities in the case of their country, though until recently their own efforts, in view of the stupendous size of the country and extent of its population, were quite trivial. But the return of the Boxer Indemnity by the United States with the restriction that it be used for educational purposes has made possible the sending abroad of Chinese students on a large scale.

We have precisely these same needs and the same problems in the Philippines. That the various attempts to meet these needs have been altogether inadequate is now patent. It is reasonable that the matter should be judged principally from the viewpoint of the most important activity of the Filipino people and the chief source of their material wealth, and this means AGRICULTURE. A College of Agriculture for the collegiate instruction of young men in this important work was established ten years ago. Since that time this College has received more than one thousand students. But a large proportion of these students did not remain at the College long enough to graduate; having derived very material benefits from the one to three years stay at the College, they left, largely to return to active practical work in the provinces. The number of men of superior ability or with resources sufficient to enable them to remain through four or six years has been comparatively small. Efforts are now being made to increase the proportion of students who graduate, without at the same time lowering the requirements.

Constant calls, of the most urgent nature, are being made by various departments of the Insular Government for graduates of the College of Agriculture. So insistent have these demands been that almost every graduate has been employed in connection with the agricultural development of the Islands, under the Civil Government, as soon as he completed his work at the College. Last year there were registered with the Dean of the College of Agriculture urgent demands for morethan eighty men, when the College had, during that year, only thirty-three graduates.

The necessity of producing a competent Filipino faculty for the College of Agriculture has required a most intensive search for men of the right type and has required the greatest possible effort to secure suitable advanced training for such men. For this purpose alone, the ten years life of the College has produced and finally brought back to the institution from higher training abroad only four men for the permanent faculty of the College of Agriculture.

For practical application of known scientific methods to Philippine Agriculture, the preparation that a student obtains at the College of Agriculture is sufficient. For building up a Filipino faculty for the College of Agriculture and organizing a staff of investigators for the Experiment Station, however, much additional training of a higher character is absolutely essential. To obtain highly trained men, the most promising students among our graduates must be sent to foreign universities. The Filipinos with advanced training, now on the Faculty, are not equal in number to the decrease by resignation of the Americans; the number of students now abroad for study is so small that it will not provide for possible future decrease of the American staff (by resignation), to say nothing of providing for increase in staff made necessary by increase in enrollment. This had resulted in such a serious condition that in 1918 the Board of Regents authorized the employment of a considerable number of additional men from America for the College of Agriculture. Great difficulty is being experienced, however, in employing these men, since the salaries authorized in 1918 are not large enough to attract the right men. Consequently, there is more urgent need than ever to increase the number of Filipinos being sent abroad. This situation has been met in a partial and too general way by the Insular Government, by the appropriation of three hundred thousand pesos for sending students abroad.

It is a matter of great regret that Agriculture has obtained so small a percentage of these new pensionadoships. For the purpose of building a Filipino faculty at the College of Agriculture, the University of the Philippines is now supporting, through regular channels, only four Fellows in the United States. In addition, three pensionados have been sent from this College under the recent appropriations made by the Legislature. It is quite needless to say that for the sciences underlying agriculture, this number is wholly insufficient for the needs of the country. The situation is extremely serious and urgent, and one thoroughly worthy of the attention of those Filipinos who have the soundest constructive hopes for the future of this Archipelago.

COMPLETE LIST OF UNIVERSITY FELLOWS IN AGRICULTURE TO AUGUST, 1919

Manuel L. Roxas, Ph.D.,
Entered Wisconsin University, July, 1914, Ph.D. in 1916.
Also took advanced work in Boston Institute of Technology,
Now Associate Professor of Chemistry,
College of Agriculture, U. P.

B. M. Gonzalez, M.S.,
Entered Wisconsin University, July, 1914, M.S. in 1916.
Now Associate Professor of Animal Husbandry,
College of Agriculture, U. P.

Nemesio B. Mendiola, Ph.D.,
Entered Cornell University, August, 1916, Ph.D. in 1918.
Now Assistant Professor of Agronomy (Plant Breeding),
College of Agriculture, U. P.

Rafael B. Espino, Ph.D.,
Entered Johns Hopkins University, June, 1917, Ph.D. in 1919.
Now Instructor in Crop Physiology,
College of Agriculture, U. P.

Jose J. Mirasol, M.S.,
Attending Illinois University; Agronomy and Economics.

Francisco A. Quisumbing, M.S.,
Attending Columbia University; Chemistry.

Leopoldo B. Uichanco, M.S.,
Attending Bussey Institution, Harvard University; Economic Entomology and Zoology.

Francisco O. Santos, M.S.,
Attending Yale University; Chemistry.

Valente Villegas, B.Agr.,
Government Pensionado, attending Iowa State College; Animal Husbandry.

Francisco M. Fronda, B.Agr.,
Government Pensionado, attending Cornell University; Animal Husbandry.

Anastacio Teodoro, B.Agr.,
Government Pensionado, attending Wisconsin University;
Agricultural Engineering.

Charles Fuller Baker,
Dean, College of Agriculture.

A PRELIMINARY REPORT ON THE ACCLIMATIZATION OF ALFALFA [1]

By INOCENCIO ELAYDA

Of the Department of Agronomy

Next in importance to the establishment and improvement of native staple and secondary crops, is the acclimatization of foreign plants. Both of these projects can be carried on at the same time if facilities are available. In the development of Philippine Agriculture the improvement of our staple crops is the primary need. The introducing of cultures that may or may not become commercially valuable under local conditions is quite secondary. But the introduction of plants and the consequent outlay for their acclimatization and establishment have proven in several instances highly worth while. The avocados, some new varieties of corn, soy beans and other exotic forms which have been introduced and acclimatized here, are good examples of successful introductions.

Alfalfa may in time prove to be of commercial importance in certain regions of the Philippine Islands, as it is reported to be under cultivation in Hawaii, a tropical country. Regions where alfalfa is prominent as a crop possess suitable climatic and soil conditions. The most favorable growth of alfalfa is of course found in regions possessing the most favorable combination of these two sets of conditions. It seems probable that suitable conditions for the growth of alfalfa may be found in some localities in the Philippine Islands.

The object of this paper is to report tests on the acclimatization of alfalfa made during the past two years at the College of Agriculture. The extent of previous experimentation with this foreign plant in the Philippines is given in reports published by the Bureau of Agriculture. In the "Philippine Agricultural Review," one of the reports [2] reads as follows:

> Alfalfa.—Tests extending over four years have been made with this useful legume. Reports from about a score of outside sources, indicating quick germination and a 'good stand' have been received. Later reports, without exception, tell that the 'good stand' quickly 'died off'. Such was the experience of this Bureau in Batangas, where large plantings (10 or more acres each year) were made on irrigated lands. At Singalong like results were had until in 1906, when the specific alfalfa nitrogen bacterium was obtained from Washington, and a plat sown with inoculated seeds. Establishment was very slow, owing to the nearness of the water table to the surface, but as the dry season advanced growth became more rapid and strong. Two cuttings were taken, but when the following rainy season set in, the entire plat died out. Alfalfa, generally promising for a short time, has always failed, not only in Manila but everywhere in the Islands except Trinidad, and there it is still doubtful. Small plats on top of ridges were successfully carried through the past rainy season, and look promising. It is deemed very desirable to experiment further with alfalfa, especially in the inoculation of the soil.

Another report [3] also published in the "Philippine Agricultural Review" by the Bureau of Agriculture, is as follows:

> Alfalfa.—A number of experiments have been conducted by the Bureau to determine if this crop can be grown in the Philippines. The results show that where the land is limed and inoculation secured the plants will grow during the dry season, but die out in the rainy season.
>
> The results of the experiments read surprisingly like those in Florida, where thousands of trials have been made. On well drained deep soil, heavily limed, and properly inoculated, one or two, or three cuttings at best may be expected, and then the plants disappear.

---

[1] Experiment Station contribution, No. 18.
[2] Philippine Agric. Rev. **1**:78. 1918.
[3] Philippine Agric. Rev. **8**: 407. 1911.

It is altogether probable that alfalfa will thrive under irrigation in the dry season on well-drained, heavily limed, inoculated soils. It is very improbable that it can be kept alive through the rainy season. With cheap enough seed such results would justify its cultivation by a dairyman, but hardly any other type of farmer.

Alfalfa is nowhere grown with any great success in the tropics, and in any humid region its culture is difficult. These facts should be borne in mind by experimenters, as doubtless many will try to grow the crop.

TESTS AT THE COLLEGE OF AGRICULTURE

FIRST TEST

At the College of Agriculture, the first trial was made in February, 1917, and the second trial in September, 1918. For the first trial a few seeds received from Winona, Minn., were planted in the College Nursery; and for the second trial, a few seeds from the State College of Agriculture of Cornell University were used. The seeds were first started in seed flats and then transplanted in nursery rows, care being exercised in transplanting that the root system of each individual plant was not much disturbed nor damaged. The plants seemed to become established in their transplanted state; but after sending out a few new growths the old leaves began to wilt, and this was followed by the wilting of the young leaves and finally by the death of all the plants.

SECOND TEST

The second trial was made with seed from India presented to the Department of Agronomy by Mr. Pereira de Braganza, a student whose home is in Portuguese India. The seeds were secured by Mr. Pereira from Pestonjee P. Pocha & Sons, Seed Merchants, No. 8 Napier Road, Poona, British India. The seeds came with no variety name, only the label: "Lucerne, Extra Selected." In answer to an inquiry, the Seed Company stated that it could not give the variety name or furnish other varieties of alfalfa, as this variety is the only one grown in its district. These particular seeds were given the serial number 10697 in the College of Agriculture Accession Book.

To insure success, some seeds were planted directly in beds and others were started in seed flats for transplanting. In both cases, the cultures were quite successful. The seeds planted directly in beds were drilled December 12, 1918, and the germination took place two days after the date of planting. The flowering of these plants began February 5, 1919, and pods began to form on February 20, 1919. Mature pods were first harvested on April 8, 1919, and the picking of seeds continued at intervals of different lengths. By May 28, 1919, flowers and pods were still in the process of development. At the first harvesting of seeds, measurements of height and weight were made of five plants representative of lowest, second highest, and highest individuals. The following are the results: lowest from 43 centimeters to 52 centimeters in height, one plant weighing 16 grams; second highest from 75 centimeters to 85 centimeters, one plant weighing 16 grams; and the highest from 100 centimeters to 118 centimeters, one plant weighing 20.5 grams.

The seeds started in seed flats were planted on December 13, 1918, and commenced to germinate on December 18, 1918. They were transplanted in three different beds on January 15, 1919. One bed has a rather shallow soil, another is a raised bed, and the third has a fairly deep soil. In the last two beds the plants have given satisfactory results, those in the raised bed being slightly the better; but in the shallow-soil bed the plants have developed rather poorly, with

the exception of a few individual plants which compare favorably in size with many of the plants in the other beds. The plants in the shallow-soil bed began flowering on April 20, 1919, and the harvesting of ripe pods was commenced on May 5, 1919, almost one month later than in the other beds.

The last planting by the drill method was made on February 7, 1919, germination taking place two days later. The ground used was a hand-prepared bed in a field which had been previously used for a mulberry plantation. The stand was poor, owing to the seeds having become infested with weevils. The plants flowered at the same time as the culture in the shallow-soil bed. Seeds that were plump and bright yellowish in color, which are two of the main characteristics of good alfalfa seeds, were secured from every bed mentioned. No cutting to determine the yield of the forage was made of this culture of alfalfa. The plants were not disturbed at all, and they were allowed to produce seeds as long as possible, since this is the main object in this work. The ability of this Indian variety of alfalfa to produce seeds under our local conditions gives great hope of acclimatizing and improving it along profitable lines.

Plate I is a photograph, taken when the plants were in full bloom, showing a part of the drilled alfalfa bed. Complete specimens of the entire plant representing the lowest, second highest, and highest individuals of the above culture were placed in the Agronomy Laboratory for future reference.

GERMINATION AND GROWTH TESTS OF A NUMBER OF VARIETIES

In our experience with acclimatization of plants at the College of Agriculture, we have found that every effort should be made to secure as many varieties as possible of the plant which is to be acclimatized. Trials of these varieties, once they are obtained, under as many different conditions as possible, should be made and carefully observed. The trials should not be restricted to only a few varieties, for the greater the number of varieties, the greater the chance of obtaining the most desirable one in the shortest possible time. As an example of this, there was received not long ago an inquiry as to the practicability of growing the soy bean during the rainy season, as several trials made with this plant elsewhere in the Islands had not been attended with desirable results. A number of varieties of soy bean were obtained, and tests with these have shown that it may be grown profitably both in the rainy season and in the dry season.

Following a similar plan, an effort was made to introduce seeds of as many varieties of alfalfa as possible. Another object in view is to find varieties which are better adapted to our local conditions than the Indian variety and which can be more profitably grown here.

The following varieties were received from California, March 22, 1919, together with some pure cultures of bacteria for seed inoculation, through the kindness of Mr. C. F. Pennewell, the manager of Western Soil Bacteria Co., San Francisco, California:

11048 Chilcon alfalfa.
11049 Hairy Peruvian alfalfa.
11050 Smooth Peruvian alfalfa.

As the seeds came at a most unfavorable time, the weather being too dry for normal growth, extensive trials of the seeds with the use of the bacterial cultures were postponed. It was planned that one lot of seeds would be planted at the be-

ginning of the rainy season in June, and another lot in the month of November; November is the usual time for planting vegetables, because the rainfall then is not excessive. But preliminary trials were made with these varieties to test the vitality of the seeds and also to observe the behaviour of seedlings at the height of the dry season. Small beds were prepared, and these varieties of alfalfa were sown on March 29, 1919. The seedlings appeared above ground April 2, 1919, with a good percentage of germination. Thus far, the varieties *Hairy Peruvian* and *Chilcon* show vigorous growth, although many of the plants died from sunburn. The *Smooth Peruvian* showed a good germination, but all the plants succumbed to excessive heat, despite the fact that they were given artificial shade and plenty of water at regular intervals. These three varieties were again planted on May 1, 1919, by broadcast in small beds that connected with irrigation water. They are now (June 10) showing good growth, especially in patches which are reached freely by water from the irrigation ditch. The highest plant of the *Chilcon* measures 24.5 centimeters in height; that of *Hairy Peruvian* 19.4 centimeters and that of *Smooth Peruvian* 15.2 centimeters, these measurements being taken June 10, 1919.

At the time the above three varieties came, seeds of twenty other varieties of alfalfa were received from Tucson, Arizona, through Mr. W. E. Bryan, a worker in plant breeding in the Experiment Station of Arizona. The names of these varieties are given in Table I.

TABLE I.—*Growth data of varieties of alfalfa received from Experiment Station of Arizona, Tucson, Arizona.*

C. A. No.	Variety name.	Height of the highest plants.[a]	
		Planted April 12, 1919.	Planted May 3, 1919.
		cm.	*cm.*
11028	Kebilli Tunis 240	35.3	5.3
11029	Grimm 254	26.6	4.9
11030	Ecuador 276	14.6	3.7
11031	France 41	21.7	5.7
11032	Hairy Peruvian 39*a*	31.4	14.3
11033	Mexico 266	10.1	9.5
11034	Sand Lucerne 255	13.0	5.1
11035	Algeria 275	(*b*)	4.6
11036	Germany 253	22.7	11.1
11037	Italy 263	23.3	13.6
11038	Siberia 35	25.6	14.0
11039	Canada 280	(*b*)	13.8
11040	Spain 271	(*b*)	21.4
11041	Tripoli 299	16.8	25.8
11042	Siberia 251	13.4	17.1
11043	Gabes, Province of, 297	13.0	15.5
11044	Mcintyre 261	35.0	9.7
11045	Baltic	(*b*)	12.2
11046	Arabian 256	23.2	13.9
11047	Turkestan 248	(*b*)	13.0

a Measurements were taken June 10, 1919.
b Killed by heat.

Only a few seeds of each of these varieties were received. The trial thus far made for each variety has been in very small beds. The seeds were divided into small lots, so that each variety might be planted in places of different soil character and under different weather conditions. As Table I shows, seeds of all the varieties from Tucson, Arizona, were planted on April 12, 1919.

All varieties germinated, and specimens of all but five varieties are living. Some varieties are showing more vigorous and more promising growth than

others, as indicated by heights of the tallest plants of each variety appearing in Table I. The other lot of seeds of the same varieties was planted on May 3, 1919, in about the same way as the first lot. All varieties germinated; all are alive, and there is an expectation of getting comparative results from the growth of the twenty varieties.

The most encouraging result thus far is the fact that a good yield of seeds has already been secured from the Indian variety of alfalfa bearing the college number 10697. This means a step in advance in this acclimatization work, for we can hope to establish an introduced crop in a new locality only when the plant involved is able to produce seeds in its new environment. When a sufficient number of plants are available at the College, seeds grown here can be sent out for experimental purposes to parts of the Islands having different climatic and soil conditions. It may be supposed that seeds grown in the Islands would give a surer indication than newly imported seeds as to the adaptation of this particular variety to our different climatic and soil conditions; and the use of such seeds would probably lessen the time required before the crop is established in its new environment. In regard to the other varieties, while some of them in their present stage of development have shown growth and vigor comparable to those of the Indian variety at the similar stage, it is not yet time to advance any estimate as to the results of their first trial. This must be a subject of another report.

DISCUSSION OF DISTRIBUTION AND REQUIREMENTS OF ALFALFA

For further encouragement in continuing this work, a brief mention of the distribution, successful introductions elsewhere, climatic and soil requirements, and utility of the alfalfa crop, follows.

The distribution of the alfalfa crop may be considered to be dependent upon the combination of two sets of conditions, climatic and soil conditions. A country where alfalfa is grown must possess a proper combination of these two sets of conditions. In the western United States, the Mediterranean regions, Australia, Chile, Peru, South Africa and Central Asia, because of apparently very favorable climatic conditions, alfalfa is an important crop. It is the staple forage crop in the arid region of the United States, and it seems to thrive best in arid or semi-arid regions where adequate irrigation is available. It is cultivated in India and Hawaii as a forage plant of considerable value, and in these countries the plant is sown at the commencement of the wet season. The plant is said to be able to withstand the great extremes of heat and atmospheric aridity prevailing in dry subtropical countries, and no injury from heat has ever been recorded under the conditions prevailing in such places as Arizona and Punjab. India. On the other hand, where the climate is apparently less favorable, as in Mississippi, Alabama, New York, Ohio, and in other parts of the United States and in portions of Europe, this crop is commercially important because of unusually favorable soil conditions; this seems to be especially true in regions having a lime stone soil.

As specific examples of successful introduction of this plant, the case of the State of California may be cited. Alfalfa was first introduced into the United States between the years 1851 and 1854, being brought to California from Chili (Circular No. 87 of the Agricultural Experiment Station of California). Since that time its culture has spread rapidly from California to many other states. According to the same circular, it is the principal forage plant of California; and

the annual value of the crop in that state approximates thirty-five million dollars, and the area devoted to its culture is constantly increasing. The state of Arizona is an example of an arid region in the southwest of the United States to which alfalfa is especially adapted. It is reported in Bulletin No. 73 of the year 1914 of Arizona Station that within thirty years, alfalfa in that state has risen from a comparatively insignificant position to an important place in its agriculture. The report further states that one-third of all cultivated land in Arizona is devoted to alfalfa culture, and that the value of the alfalfa hay and seed surpassed that of any other single crop, and was approximately two million and a half dollars, or about 50 per cent of the total value of all field crops of Arizona.

As to soil relations of alfalfa, it may be stated that actual field experience has shown that alfalfa may be grown in practically every type of productive soil, except a soil which is acid. A rich clay soil on top of gravel or limestone is mentioned as being ideal for alfalfa. Excellent alfalfa fields are also reported to be found on deep, well-drained heavy loam soil, free from hard pan, with no standing water closer than 5 or possibly 1.3 meters. Under semi-arid conditions of climate, alfalfa is reported to do well in most types of soil, except those that are heavily charged with alkali. Wet soils are disastrous to this plant. Under such a condition success with its culture depends upon the availability of deep, fairly fertile, well-drained soils rich in lime. Although the root system of alfalfa varies with soil conditions, it has been known to grow almost straight down to a depth of 3.6 meters in a single season, and the roots of older plants have been traced to a depth of 19.5 meters.

The utility of alfalfa is highly praised in those sections where it is successfully grown. It is reported that it excels other crops in yield per unit area, in feeding value, and in its beneficial effect upon the soil. "It is a quick and reliable source of cash income from baled hay, honey and seed; it is the foundation of numerous feeding industries alone or in advantageous combination with carbohydrate feeds; it is relished by every form of livestock—poultry, ostriches, hogs, sheep, dairy cows, beef steers, mules and horses; and it is adapted to use in various forms—loose or baled hay, chopped feed or meal, as a soiling crop, as pasturage or even as silage." It usually yields five or six crops a year, the number of cuttings varying according to local conditions. In Hawaii it has given an annual yield of from 24 to 48 tons of green forage per hectare and not more than 16-$\frac{1}{2}$ tons of hay per hectare. One of the best yields obtained on the Poona farm in India was 38 tons of green fodder per hectare. In a Wisconsin bulletin[4] alfalfa hay is said to contain 11.7 per cent of protein, 40.9 per cent of carbohydrates and one per cent of fat; it thus excels, in protein content especially, all other common forage crops in the United States, and also a number of grain feeds with the exception of wheat bran, which surpasses the alfalfa hay by only two tenths per cent of protein. As a honey plant, Secretary Coburn of the Kansas Board of Agriculture states that in a favorable season 100 pounds of honey to a hive is no uncommon yield in alfalfa regions, the honey being very superior in quality. One of the most valuable characteristics of alfalfa is its ability to fix atmospheric nitrogen with the help of the bacteria contained in its root nodules. These bacteria, like those found in other leguminous plants, absorb the nitrogen from the air and convert it into a form which is available for the alfalfa plant. When the

[4]Agric. Exp. Sta. Univ. Wisconsin, Bul. 259. 1915.

roots of alfalfa die, nitrogen, in a form available for other plants, is added to the soil. It is reported in the same bulletin of the Wisconsin Experiment Station that where bacteria are present in the soil in which alfalfa is grown, a good stand of alfalfa grown under favorable conditions adds annually to an acre of soil a hundred pounds of nitrogen, or two hundred and forty-seven pounds to a hectare.

In view of the fact that alfalfa is successfully grown in Hawaii, a tropical country like the Philippines, it may be hoped that similar results may be obtained somewhere in the Islands. This hope seems to be substantiated by the success in this preliminary work in which a variety of alfalfa has been found which has produced seeds on the College Farm. Alfalfa has been shown to be well suited to an irrigated and sub-tropical region, and its culture under this climatic condition is handicapped only by the presence of alkali and acid substances in the soil. Alfalfa has also been shown to be an important crop where the climate is unfavorable to its growth, but the soil is unusually favorable. It is not unlikely that one or both of these requirements may be found in the Islands in varying degrees of suitability. There are regions in the Islands, like the island of Mindanao and elsewhere, where the rainfall is rather evenly distributed. There is no question that in default of favorable climate for alfalfa, there can be found in the Islands soils which will undoubtedly meet the soil requirements of this crop; and probably there are altitudes where weather conditions may at least approximate the ideal climate in alfalfa regions. Because of heavy rainfall in many sections of the Islands, our soil is not likely to have an accumulation of alkali that would be injurious to the growth of alfalfa. Acid soils which are prohibitive to alfalfa culture, excessive moisture during wet weather and the long dry season in most sections of the Islands can be more or less artificially corrected. Consequently the problem is to find varieties of alfalfa that are or can be adapted to the diversity of conditions prevailing in the Islands.

In the meanwhile, we may very well speculate upon the possibility of alfalfa in the Philippines. With the results obtained at the present stage of this preliminary work, alfalfa may become a very important forage crop in the Islands.

ILLUSTRATION

PLATE I

Photograph, taken when plants were in full bloom, showing a part of the drilled alfalfa bed, at the College of Agriculture.

PLATE I. ALFALFA AT THE COLLEGE

FOOT-AND-MOUTH DISEASE AT THE COLLEGE OF AGRICULTURE[1]

By B. M. Gonzalez
Of the Department of Animal Husbandry

The epidemic of foot-and-mouth disease which caused serious losses in many sections of the Islands in 1918 and 1919 made no exception of the College of Agriculture.

Rinderpest has raged in the towns surrounding Los Baños and in Los Baños itself, three times within the last three or four years; but it did not affect the College herd, because strict quarantine on the College Farm was observed while the disease was in the neighborhood. No animal, except calesa horses that were not permitted to leave the road, was allowed to enter the College grounds. Stray animals, as pigs, dogs, chickens, pigeons, were shot down at sight. Because of the isolated location of the College at the base of Mount Makiling, it is not difficult to enforce quarantine against the populated areas.

During the last epidemic of foot-and-mouth disease, however, the quarantine measures which heretofore proved effective against both rinderpest and foot-and-mouth disease failed to keep the latter disease out. This raises the presumption that the disease did not come from the populated areas. There is only one other possible source from which it might have come, and that is Mount Makiling.

Hunters on Mount Makiling remarked during the rage of the epidemic that the deer seemed to be suffering from some disease which lamed them and made them easier to catch. This report seems to be corroborated by the fact that several times venders appeared on the Campus with venison, a thing which seldom occurs. It appears, therefore, that infection came from the deer of the mountains which have access to the College pastures on the hillsides. Where the deer contracted the disease is not known, but the towns of Calamba and Batangas, which were badly infected by the disease at the time, extend into the foothills of Mount Makiling.

Animals affected.—The disease made its first appearance on January 24, 1919, and the last animal attacked became sick February 5. Table I shows the total number of animals and the number affected by the disease.

Table I.—*Total number of animals on the College Farm, and the number diseased.*

Animals.	Total number.	Number affected.
Horses	4	0
Work Bullocks		
Native	19	8
Chinese	4	0
Indo-Chinese	4	0
Nellore Breeding herd	13	0
Indian Buffaloes	4	0
Indo-Chinese Buffalo Bull	1	0
Carabaos		
Grown up	8	8
Young Stock	6	6
Goats	11	0

[1] Experiment Station contribution, No. 19.

It may be assumed that all these animals were equally exposed; there is no reason to believe otherwise, since they all roamed over the same area. But we find that the horses, Nellore cattle, Indian buffaloes, Indo-Chinese and Chinese cattle, and native goats were not affected.

The horse is known to be naturally immune to the disease.

Of the nineteen native bullocks that the College owns, eight contracted the disease, five mildly and three rather severely. These animals ranged in age from 6 to 13 years, and came originally from Batangas province.

The Chinese and Indo-Chinese bullocks have been on the College Farm for about nine years; during this time there has never been a case of foot-and-mouth disease on the Farm. Whether these had contracted the disease at some time before the epidemic, can not be ascertained; but if they had, they must have conserved their immunity throughout these years.

Some of the Nellore herd and the Indian buffaloes have not been on the Farm very long. They were from a recent importation of the Department of Agriculture and Natural Resources. While in quarantine at Pandacan, these animals contracted foot-and-mouth disease. Five of the Nellores were from Alabang, from a much earlier importation and nothing is known of their history.

All the carabaos contracted the disease. These animals varied in age from two months to fourteen years and with the exception of two calves are pure natives from Zambales. The male parent of these two calves was an Indo-Chinese (Cambodge) bull, the female parents, two native cows; the calves were born at the College.

The strangest case presented was the perfect immunity of the goats. As the cattle became sick, they were put in the goat pen for quarantine, this being the most convenient location for isolation. The goat flock is not considered of any special value, being of the common native stock. The original goat stock was brought to the College about ten years ago. Except for the introduction of one or two outside bucks, all of the present flock are native of the place and have never been in contact with the foot and mouth disease before.

Course of the disease.—All of the infected animals contracted the disease within a period of 13 days, from January 24 to February 5, and all had recovered within a month from the first case. The usual course of the disease took from 12 to 25 days with an average of 18 days.

Symptoms.—The usual symptoms observed were the appearance of ulcers around the mouth and on the tongue and on the feet. These ulcers took the form of suppurating pustules which at times became so painful as to keep the animal from eating and keep him lying down. In the milder cases, the animals stood on their feet and apparently did not suffer. They walked around and grazed. The severest case observed was that of a native bullock which refused to eat for five days. None of the calves were affected severely; two carabao cows and one bullock had their hoofs injured so badly that up to this time (six months later), they are unable to work regularly because of soreness of the feet.

Treatment.—The treatment given was rest, disinfection with creoline solution, and application of a mixture of vaseline, creoline, and tar. The mixture served as a fly repellent, also, as these insects irritated the animals considerably, especially about the feet. The animals were treated twice daily. They were given fresh green grass and in general recovered sufficiently to be able to do light work within one month.[2]

[2] The details of the treatment of these animals were entrusted to the care of Mr. Jose P. Esguerra, Assistant in Animal Husbandry for the Experiment Station.

FEEDING EXPERIMENTS ON DRAFT CATTLE [1]

By Francisco P. Lago

The experiments discussed in this article were undertaken in an effort to find feeds suitable as supplements to native pastures for work bullocks. The usual sources of agricultural information were consulted, mainly the volumes of the *Experiment Station Record*, but nothing along this line was found. Evidently not much work has been done on the subject. The series of experiments here presented have for their objects the following: The effect of different supplementary feeds (*a*) on the weight of work bullocks; and (*b*) on their health and ability to endure work. Comparisons were made with native pasture supplemented with corn and other forages that may easily be grown in the Philippines. The experiments cover a period of almost two years, and were conducted in the College of Agriculture at Los Baños.

GENERAL PLAN

On August 25, 1917, the feeding experiments were begun on farm draft bullocks involving five teams of two animals each. In each test ten bullocks were used and they were divided into two lots. One lot was to receive one kind of feed in addition to what they got in the pasture. In these experiments only two kinds of feed were compared at a time, one kind being fed to one lot and the other kind to the other lot. Each team of bullocks was worked together if the work could be done by two animals. But if the work was done by one animal, each member of the team was given the same kind of labor for the same length of time. Thus, the amount of work done by the two bullocks of each team was practically the same. Likewise, the amount of work done by the bullocks of one lot, receiving one kind of feed, was the same as that of the bullocks of the other lot, receiving another kind of feed.

The work of the bullocks may be divided into three classes,—hard labor, medium labor, and light labor. Hard labor involved such work as plowing, pulling a disc harrow and hauling earth for leveling a road. Light labor involved such work as making furrows, planting (pulling the planting machine) and hauling a cart over a good road. Medium labor involved such work as cultivation, harrowing and hauling a sledge. Each team was scheduled to work four times a week from about half-past seven to eleven o'clock in the morning and from one o'clock to four o'clock in the afternoon.

In these tests five different experiments were conducted: (1) native pasture supplemented with ears of corn compared with native pasture alone; (2) native pasture supplemented with sugar cane tops compared with native pasture supplemented with corn fodder; (3) native pasture supplemented with Guinea grass compared with native pasture supplemented with corn fodder; (4) native pasture supplemented with Japanese cane compared with native pasture supplemented with corn fodder—that is, Japanese cane compared with corn fodder.

---

[1] Thesis presented for graduation from the College of Agriculture, No. 78; Experiment Station contribution, No. 20.

In the beginning of each experiment, the average weight of each animal for three successive weekly weighings was taken and used as the basis for dividing the animals into two uniform lots according to weight. Then the weekly weight of the animals from the beginning to the end of each experiment was carefully recorded for comparison. The initial weight of each bullock was found by averaging three values: the weight one week before beginning the experiment, the weight at the beginning, and the weight one week later. The final weight was found, also, by averaging three values: the weight one week before the experiment closed, the weight at close, and the weight one week later. The animals were weighed at about seven o'clock in the morning—just after bringing them from the pasture.

PLAN OF FEEDING

The plan of feeding the bullocks in Experiments I, II, III, and IV was to feed only the animals that were working; the ones that were not working were left in the pasture. Every morning at eleven o'clock the bullocks that were working were brought to the stable and fed. They were left in the stable until one o'clock in the afternoon. At the close of the afternoon work the bullocks were taken to the same pasture for the night. In Experiment V, however, a different plan was followed. Lot I was fed exclusively on Japanese cane and Lot II on corn fodder. The feed that was given to each bullock was carefully weighed and recorded, and any refuse left was weighed back and deducted from the amount fed. Before and after feeding, the animals were always given water.

THE BULLOCKS

The bullocks used in these experiments were selected from the herd of work cattle belonging to the College. They were of Chinese, Indo-Chinese and Native breeds. In selecting these animals an effort was made to get bullocks that were uniform and could be made into teams of two bullocks each. All the animals used in the different tests were in good condition and properly cared for. The names of the animals, the breeds, and the ages are shown in Table I.

TABLE I.—*Animals used in different tests.*

Names of bullocks.	Breed.	Approximate Age (1917-1918).
		Years
Cambing	Chinese	13
Binabae	Indo-Chinese	11
Pandac	Chinese	13
Andres	Chinese	13
Laylay	Indo-Chinese	11
Pungal	Indo-Chinese	11
Alipante	Indo-Chinese	11
Malukong	Native	11
Juan	Native	7
Isabelo	Native	8
Egmidio	Native	8
Doroteo	Native	11
Pedro	Native	6

THE PASTURES

During the experiments there were six places where the animals were pastured—Pag-itan, Lagaan, Tanza, Coffee Plantation, Young Coconut Plantation, and Tungtungin. Data relating to pastures are shown in Table II. These places are the pasture lands of the College. During the experiments there were about fifty animals (including all the bullocks under experiment) roaming in these pastures. The area of these pastures is not known, but it was noticed that by rotation of the pastures, they furnished sufficient feed for this number of animals.

From June to February, so long as the weather was favorable, the pastures remained in fairly good condition. They became poor, however, during March, April, and May when the weather was dry. But even then they could maintain the animals. When the pastures became short the cattle were pastured on the College Farm in places where there were no crops growing.

TABLE II.—*College native pastures.*

Name of place.	Vegetation.[a]
Pag-itan	*Imperata cylindrica* (L.) Beauv. *Paspalum conjugatum* Berg. *Saccharum spontaneum* L. *Andropogon halepensis* (L.) Brot. *Rottboellia exaltata* L. f. *Mimosa pudica* L. *Panicum sp.*
Tanza	*Imperata cylindrica* (L.) Beauv. *Saccharum spontaneum* L. *Paspalum conjugatum* Berg. *Andropogon halepensis* (L.) Brot. *Rottboellia exaltata* L. f. *Mimosa pudica* L. *Panicum sp.*
Lagaan	*Imperata cylindrica* (L.) Beauv. *Saccharum spontaneum* L. *Paspalum conjugatum* Berg. *Cynodon dactylon* (L.) Pers. *Rottboellia exaltata* L. f. *Panicum flavidum* Retz.
Coffee Plantation	*Paspalum conjugatum* Berg. *Imperata cylindrica* (L.) Beauv. *Saccharum spontaneum* L. *Rottboellia exaltata* L. f. *Panicum sp.* *Cynodon dactylon* (L.) Pers. *Mimosa pudica* L.
Young Coconut Plantation	*Imperata cylindrica* (L.) Beauv. *Saccharum spontaneum* L. *Paspalum conjugatum* Berg. *Andropogon halepensis* (L.) Brot. *Rottboellia exaltata* L. f.
Tungtungin	*Imperata cylindrica* (L.) Beauv. *Saccharum spontaneum* L. *Andropogon halepensis* (L.) Brot. *Leucaena glauca* (L.) Benth. *Paspalum conjugatum* Berg. *Rottboellia exaltata* L. f. *Mimosa pudica* L.
College Farm	*Paspalum conjugatum* Berg. *Imperata cylindrica* (L.) Beauv. *Saccharum spontaneum* L. *Rottboellia exaltata* L. f. *Panicum sp.* *Panicum flavidum* Retz. *Digitaria consaguinea* Gaudich. *Desmodium triflorum* (L.) DC. *Panicum colonum* L.

[a] Arranged according to their relative abundance.

EXPERIMENT I

OBJECT OF THE EXPERIMENT

The object of this experiment was to compare native pasture supplemented with ears of corn with native pasture alone.

PLAN OF THE EXPERIMENT

On August 25, 1917, ten bullocks of the College were selected. The average weight of each animal for three successive weekly weighings was found, and the bullocks were divided by weight into two uniform lots.

Lot I was given ears of corn. The sum of the average weights of this lot was 1947 kilograms. Lot II was turned into pasture. The sum of the average weights was 1951 kilograms. The weekly weight of each animal in both lots was recorded during the period of the experiment.

Every morning at eleven o'clock the working animals of Lot II were pastured, and those of Lot I were brought to the stable and fed with ears of corn. For the first three successive feedings they were given ten ears each; the next three, fifteen ears; the next three, twenty ears; the next, twenty-five; the next three, thirty ears. This ration of thirty ears was maintained throughout the remaining time of the experiment. The ears of corn given to each animal at every feeding were weighed, and if there were any left unconsumed, they were weighed and substracted from the amount given. With the exception of *Pandac* and *Andres* the animals were able to consume all of the ration given to them. Animals not working were fed no grain.

On October 20, 1917, the experiment was reversed. Lot II was given corn as supplement and Lot I was turned to pasture with no other feed. The same plan of feeding was followed. The animals in Lot II were able to consume all their daily ration throughout the test.

THE CORN USED

The corn that was used in this experiment was Native Yellow Flint from the Agronomy Department. It had a good quality of grain.

THE PASTURE

During the first part of the experiment the animals were pastured in seven different places, namely, Lagaan, Pag-itan, Tanza, Young Coconut Plantation, College Farm, and Guinea grass field. During this experiment the pastures were all in fairly good condition as it was the rainy season. When the lots were reversed the same pastures were used. But toward the end of the test the pastures became poor, so the Coffee Plantation was used in addition.

METHOD OF DETERMINING THE AMOUNT OF SHELLED CORN FED

The amount of corn (shelled corn) grain given to each animal at every feeding was determined in the following manner. Twenty-five ears were weighed, then shelled and the weight of the grain recorded. A quotient was obtained by dividing the weight of the grain of 25 ears by the weight of 25 unshelled ears. Then the weight of ears of corn given at each feeding, multiplied by the quotient just mentioned, gives the amount of shelled corn fed. Nearly uniform ears were selected for each feeding.

In the first part of this experiment both lots decreased in weight and in the same proportion. This is designated as Experiment I-A and lasted from August 25, 1917, to October 19, 1917. Lot I which was fed with corn as supplement decreased 20.04 kilograms, and Lot II on pasture, 20.2 kilograms in weight. They showed practically no difference at all.

TABLE III.—*Summary table of weights and feed given.*

		Experiment 1-A.		Experiment 1-B.		Experiment 1-C.	
		Lot I. Corn and pasture.	Lot II. Pasture alone.	Lot I. Pasture alone.	Lot II. Corn and pasture.	Lot I. Pasture alone.	Lot II. Corn and pasture.
1.	Number of days of experiment	56*a*	56*a*	56*b*	56*b*	30*c*	30*c*
2. (*a*)	Total initial wt. of the animals, (5 in each lot), *Kg.*	1925.64	1902.9	1905.6	1882.7	1819.2	1840.6
(*b*)	Total ave. initial wt. of the animals, *Kg.*	385.13	380.6	381.4	376.4	363.84	368.12
3. (*a*)	Total final wt. of the animals, *Kg.*	1905.6	1882.7	1819.2	1840.6	1844.52	1857.05
(*b*)	Average final wt. of the animals, *Kg.*	381.14	376.4	363.84	368.12	368.8	371.41
4. (*a*)	Gain or loss, *Kg.*	—20.04	—20.2	—86.4	—42.1	+25.32	+16.45
(*b*)	Average gain or loss, *Kg.*	—3.99	—4.2	—17.56	—8.34	+4.96	+3.29
5. (*a*)	Total corn fed (shelled), *Kg.*	262.24	——	——	211.46	——	170.00
(*b*)	Ave. corn fed to each animal (shelled), *Kg.*	52.45	——	——	42.28	——	34.00
6. (*a*)	Total days worked	99	99	96	96	54	54
(*b*)	Average days worked	19.8	19.8	19.2	19.2	10.8	10.8

a Aug. 25, 1917 to Oct. 19, 1917.
b Oct. 20, 1917 to Dec. 14, 1917.
c Dec. 15, 1917 to Jan. 14,1918.

On October 20, 1917, the lots were reversed, so that Lot I which was receiving corn in addition to pasture was turned to pasture and Lot II was given corn in addition to pasture. This is designated Experiment 1-B. The test was carried on for 56 days, the length of the previous test, for comparison. (See Table III.) The total number of days that the animals worked in the first test was 99 days and 96 days in the second; thus in both cases the animals worked almost equally. As to the amount of corn fed, Lot I consumed 262.24 kilograms in the first test and Lot II, 211.46 kilograms in the second test, giving a difference of 50.78 kilograms. This difference was not due to the appetite of the individual, for each animal was given exactly the same number of ears at every feeding as in the first test; this difference of weight was due to the number of days they were fed and to the size of the ears.

Both lots decreased in weight, as in the previous test. However, Lot II, having corn supplement, decreased only 42.1 kilograms, while Lot I, on pasture alone, decreased 86.4 kilograms. If we assume that the loss of weight in both lots was due to hard labor during the second test, then the animals receiving corn maintained their weight better than the animals on pasture alone. If this loss in weight was due, however, to the poor condition of the pasture, then using ears of corn supplement gave an advantage.

In order to test this comparison further, the experiment was prolonged 31 days, Experiment I-C. The result obtained was that Lot I increased 25.32 kilograms, and Lot II, the grain fed lot, only 16.45 kilograms.

It was noticed that throughout the experiment the animals that were fed corn passed a considerable quantity of grain in their feces. This was especially true of *Pandac* and *Andres*. As there was no chemical analysis made of the dung, it was not determined how much undigested grain was passed or by which animal.

As to health, although the animals in either case decreased in weight, yet they remained in fairly good working condition throughout the experiment. There was no noticeable difference in the spirit or the ability of the animals to endure hard work. The day laborers using the animals were frequently asked as to the spirit and endurance of the animals, and they reported that no difference could be noticed.

In work animals a great increase in weight, as in fattening or growing animals, could not be expected. They will either maintain or lose weight because a considerable part of food nutrient that they get is spent for furnishing energy and for repairing broken down tissue instead of growth and fattening. Such fluctuations are bound to occur according to the food supply and the amount of work done.

It appears from the above experiment that supplementing native pastures with corn grain in amounts varying from two to three and a half kilograms had no substantial effect on the work bullocks, weighing approximately 350 kilograms.

EXPERIMENT II

OBJECT

The object of this experiment was to compare native pasture supplemented with sugar cane tops with native pasture supplemented with corn fodder.

PLAN OF THE EXPERIMENT

This experiment was begun on March 16, 1918, and closed on April 27, 1918, covering a total of 42 days. The same animals that were used in Experiment I, except *Binabae*, were used also in this experiment. For the purpose of having a better combination *Cambing* was substituted for *Binabae*, the former work-mate of *Pandac*. The average weight of the bullocks for three successive weekly weighings was found, and the bullocks were divided by weight into two nearly equal lots of five bullocks each.

Lot I was fed with sugar cane tops and called "Sugar Cane Lot". The sum of the average weights of this lot was 1886 kilograms.

Lot II was fed with corn fodder and called "Corn Fodder Lot". The sum of the average weights of this lot was 1878 kilograms.

Every morning the feeds were cut in the field and brought to the stable. As the College had no feed cutter, the sugar cane tops and corn fodder were cut up with a bolo. This method is a little difficult and it takes time. So the feeds were prepared one and one-half hours before feeding time. As soon as the feeds were cut they were weighed and put into the stall of each working animal. There was no fixed amount of feed given to each bullock. They were fed as much as they could consume. A separate record of the amount given to each animal was kept, and any amount left was weighed back and deducted from the total amount given.

It was observed at the beginning of the experiment that the "Sugar Cane Lot" ate only a little of their feed, for the reason, perhaps, that they were not accustomed to it. So at each feeding a small quantity of salt was dusted over the feed to make it palatable. After a few days they became accustomed to it and consumed a little more. But even then they did not eat as much sugar cane as the "Corn Fodder Lot" did fodder. This is due to the fact that the sugar cane tops were coarse and hard and therefore difficult for the animal to chew. Apparently before they could consume all they needed their jaws were tired.

The "Corn Fodder Lot" ate about twice as much as the "Sugar Cane Lot". But near the end of the experiment, when the corn fodder became dry, the consumption was less than at the beginning.

FEEDS USED

The sugar cane tops that were used in this experiment were Hawaii H-20, H-16, H-69 and Sinandoyong varieties. The three varieties from Hawaii were

taken from those grown by Mr. D. Villadolid for his thesis; the Sinandoyong was from the sugar cane field of the Agronomy Department.

The corn fodder used was taken from the dry season culture corn field of the Agronomy Department. The stalks were generally small with small ears. It was a yellow flint variety.

PASTURES

During the experiment the animals were pastured in three places only—Pagitan, Tanza and Young Coconut Plantation. As it was during the dry season the vegetation in all of these places was somewhat dry. Nevertheless, with proper rotation of pastures, there was enough feed for the animals.

TABLE IV.—EXPERIMENT II.—*Summary table of weights and feed given.*

		Lot I. Sugar cane Lot.	Lot II. Corn fodder Lot.
1.	Number of days of experiment[a]	42	42
2.	Number of Animals	5	5
3. (*a*)	Total initial weight of the animals, *Kg*	1876.8	1892.6
(*b*)	Average initial weight of the animals, *Kg*	381.4	378.5
4. (*a*)	Total final weight of the animals, *Kg*	1891.5	1918.1
(*b*)	Average final weight of the animals, *Kg*	378.2	383.62
5. (*a*)	Gain or loss, *Kg*	+14.7	+25.5
(*b*)	Average gain or loss, *Kg*	3.2	5.12
6. (*a*)	Total feeds consumed, *Kg*	612.15	1190.71
(*b*)	Average feed consumed, *Kg*	122.4	238.14
7. (*a*)	Total possible days worked	88	88
(*b*)	Average days worked per animal	17.6	17.6

[a] Dates: March 16, 1918 to April 26, 1918.

Table IV shows that both lots increased in weight, the "Sugar Cane Lot," 14.7 kilograms and the "Corn Fodder Lot," 25.5 kilograms.

As to the amount of feed consumed, the "Sugar Cane Lot" consumed 612.15 kilograms and the "Corn Fodder Lot" consumed 1190.71 kilograms, or about twice as much as the "Sugar Cane Lot". Thus, 41.6 kilograms of sugar cane tops and 46.6 kilograms of corn fodder, respectively, were consumed to produce one kilogram of gain, giving sugar cane tops a slight advantage over corn fodder in this respect.

As far as consumption of feed was concerned, therefore, sugar cane tops proved to be more economical, but in total gains produced, corn fodder was better, as the animals could consume more of it and produce correspondingly larger gains.

It is a common practice in the Philippines in harvesting sugar cane to leave the tops in the field and burn them later. Thus, there is a large amount of feed wasted every year.

EXPERIMENT III

OBJECT

The object of this experiment was to make a comparison between native pasture supplemented with Guinea grass, and native pasture supplemented with corn fodder.

PLAN OF THE EXPERIMENT

On August 17, 1918, this experiment was begun and closed on September 27, of the same year, covering 42 days. The same ten bullocks that were used in Experiment II were used also in this Experiment. The average weight of the bullocks for three successive weekly weighings was found, and then they were divided into two lots of five bullocks each. The lots were nearly equal in weight.

Lot I was given Guinea grass and called, "Guinea Grass Lot". The sum of the average weights of this lot was 1897 kilograms. Lot II was given corn fodder and called, "Corn Fodder Lot". The sum of the average weights of this lot was 1895 kilograms.

In this experiment the same system of feeding as in Experiment II was followed. The only difference was that the fodder was cut up with a machine instead of with a bolo. The Guinea grass was fed as it was cut from the field.

In the third week of the experiment *Cambing* contracted a bog spavin on the hock joints of both legs and could not be worked, so *Cambing* and his workmate, *Pandac*, were dropped and only eight bullocks were used throughout the experiment. The weekly weight of each animal was recorded as before, for comparison.

FEEDS USED

The Guinea grass used in this experiment was taken from the two lots of Guinea grass on the College Farm. The record of the Agronomy Department shows that these were planted May 5, to 10, 1916. The stand was rather poor, as it was over-grazed.

Before the experiments started, one of the fields was cultivated; but being in poor condition it did not revive as was expected. Therefore, when the experiment was begun the Guinea grass that was used during the first two weeks was taken from the adjoining field. It was old and had gone to seed, and the animals did not eat it well. After two weeks the feed was taken from the cultivated field. It was young and tender, and the bullocks ate it much better.

The corn fodder used was planted purposely for forage. It was planted with the corn-planter at a distance of 75 centimeters between the rows and about 45 centimeters between the hills. The stalks were exceptionally thick and tall, but the ears were small and poorly developed. Feeding was begun before the milk stage of the corn, but before the end of the experiment most of the stalks were drying.

THE PASTURE

The same pastures that were used in Experiment II and Tungtungin in addition were used in this experiment. As it was the rainy season the vegetation on all of them was fresh and abundant; Tungtungin which was newly opened for grazing was especially good.

TABLE V.—EXPERIMENT III.—*Summary record of weights and feed given.*

		Lot I. Guinea grass Lot.	Lot II. Cornfodder Lot.
1.	Number of days of experiment	42	42
2.	Number of animals	4	4
3. (*a*)	Total initial weights of the animals, August 17, 1918, *Kg*	1515	1534.9
(*b*)	Average weights of the animals, August 17, 1918, *Kg*	378.75	383.92
4. (*a*)	Final weights of the animals, September 28, 1918, *Kg*	1537.3	1533
(*b*)	Average weights of the animals, September 28, 1918, *Kg*	384.42	383.3
5. (*a*)	Gain or loss, *Kg*	+22.3	—1.9
(*b*)	Average gain or loss, *Kg*	+5.67	—0.62
6. (*a*)	Total feed consumed, *Kg*	944.8	1314.9
(*b*)	Average feed consumed, *Kg*	238	328.72
7. (*a*)	Total days worked	88	88
(*b*)	Average days worked	22	22

Table V shows that both forages maintained satisfactorily the weights of the work bullocks. The total feed consumed by the "Guinea grass Lot" was 944.8

kilograms; and the gain in weight was 22.3 kilograms or 42.4 kilograms feed for every kilogram gain, and that of the "Corn Fodder Lot" was 1314.9 kilograms; and the loss in weight was 9 kilograms. Of the two forages, Guinea grass proved the better.

At the beginning of the experiment when the corn fodder was very fresh the "Corn Fodder Lot" consumed more feed. But near the end of the experiment when the corn was dry the consumption became less. During the first two weeks of the test the "Guinea Grass Lot" was given Guinea grass which had gone to seed and the consumption of feed was less. During the rest of the time the animals were given young forage, and the consumption became greater and greater as the feed was relished by the animals.

As to the spirit and endurance of the animals at work there was no noticeable difference.

EXPERIMENT IV

OBJECT

The object of this experiment was to make a comparison between the effects of native pasture supplemented with Japanese cane, and native pasture supplemented with corn fodder.

PLAN OF THE EXPERIMENT

On November 9, 1918, this experiment was begun and it closed on December 13, 1918, covering a total of 36 days. The same animals that were used in Experiment III, except *Doroteo*, were used also in this experiment. *Andres* was substitued for *Doroteo*. The average weight of each bullock for three successive weekly weighings was found. The animals were divided by weight into two uniform lots.

Lot I was fed Japanese cane and called "Japanese Cane Lot". The sum of the average weights of this lot was 1953 kilograms. Lot II was fed corn fodder and called "Corn Fodder Lot". The sum of the average weights of this lot was 1951 kilograms.

The same method of feeding as in Experiments II and III was followed in this test. The weekly weight of the animals was recorded, as before, until the end of the experiment.

FEEDS USED

The Japanese cane that was used in this experiment was the Japanese purple cane from Calauang that was planted on the College Farm on May 19, 1916. When the experiment was begun the average length of the canes was about 75 centimeters. The canes were hard, so the feed-cutter was adjusted to cut three-fourths of an inch in length. The practice of dusting a small quantity of salt over the feed was also followed here.

The corn fodder that was used in this experiment was planted purposely for forage. The stalks were small and only a few plants produced ears.

PASTURES

The pastures used in this test were Pag-itan, Tanza and College Farm. The vegetation during the experiment was in good condition.

TABLE VI.—EXPERIMENT IV.—*Summary record of weights and feed given.*

		Lot I. Japanese cane lot.	Lot II. Corn fodder lot.
1.	Number of days of experiment	35	35
2.	Number of animals	5	5
3. (*a*)	Total initial weights of the animals, November 9, 1918, *Kg.*	1919.7	1948.3
(*b*)	Average weights of the animals, November 9, 1918, *Kg.*	383.94	389.6
4. (*a*)	Final weights of the animals, December 14, 1918, *Kg.*	1893.1	1979.9
(*b*)	Average weights of the animals, December 14, 1918, *Kg.*	378.62	395.94
5. (*a*)	Gain or loss, *Kg.*	—26.6	+31.6
(*b*)	Average gain or loss, *Kg.*	—5.32	+6.34
6. (*a*)	Total feed consumed, *Kg.*	498.3	1245.8
(*b*)	Average feed consumed, *Kg.*	99.66	249.16
7. (*a*)	Total days worked	75	75
(*b*)	Average days worked	15	15

The results obtained are given in detail in Table VI. The total feed consumed by the "Japanese Cane Lot" was 498.3 kilograms, and there was a loss in weight of 26.6 kilograms for the lot. The "Corn Fodder Lot" consumed 1245.8 kilograms of corn fodder, which was about three and a half times as much as the "Japanese Cane Lot," and gained 31.4 kilograms in weight. The average consumption of Japanese cane by each animal at each feeding was only about six kilograms, and of corn fodder about 16 kilograms. The failure of the animals to take as much Japanese cane forage as corn fodder was probably because the cane part of the forage was hard and coarse and fibrous and the animals were not given sufficient time to chew their cud before they were put to work again. Otherwise, they would probably have consumed more.

EXPERIMENT V

In order to further study which of the two feeds, Japanese cane or corn fodder will give the better result for feeding work bullocks, it was decided to conduct another test for a period of 26 days. In this test, the feeds were used exclusively.

OBJECT

The object of this experiment was to compare corn fodder with Japanese cane when fed alone to work-bullocks.

PLAN OF THE EXPERIMENT

The animals that were used in this experiment, with the exception of *Cambing*, were the same animals used in Experiment III. *Pedro* was substituted for *Cambing*. The average weight of each animal was found, and they were divided by weight into two almost uniform lots as in previous experiments.

Lot I was given Japanese cane and called "Japanese Cane Lot". The sum of the average weights of this lot was 1922 kilograms. Lot II was given corn fodder and called "Corn Fodder Lot". The sum of the average weights of this lot was 1909 kilograms.

In this test the same method of preparing feeds as in the previous experiments was followed.

Since the animals were fed with corn fodder and Japanese cane exclusively, they were fed three times every twenty-four hours. The first feeding was from four o'clock in the morning until they were set to work at about ten minutes past six. Feeding was done at this time, so that the animals that were scheduled to work for the day could get their feed before working. The second feeding was at noon from eleven o'clock to one o'clock. The third feeding was from four o'clock in the afternoon, after the work, until they were satisfied. The teams that were

not scheduled for work were allowed to feed until satisfied and then were taken away from the stable. In the evening after feeding, the bullocks were taken from the stable, and for the night, tied in the field where there was practically no grass. So as to have feed accessible, each of them was provided at night with a box containing a known amount of feed. The feed left in the box was weighed in the morning and subtracted from the total amount of feed given during twenty four hours.

FEEDS USED

The Japanese cane that was used in this experiment was taken from the same field as in Experiment IV. But this time it was the rattoon growth that was mostly used.

The corn fodder used in this test was planted purposely for forage. It was planted with the corn planter at a distance of about seventy-five centimeters between the rows and about forty centimeters between the hills. The plants were medium in size and the majority had produced medium ears.

The initial and the final weights, the total and the average feeds consumed by the individual animal, may be seen in Table VII, which shows that the individuals in the "Japanese Cane Lot" consumed less feed than those in the "Corn Fodder Lot". In the former lot, *Pungal* consumed the least amount of feed. This animal had the habit of lying down in the stall during feeding time and would not get up to feed unless made to do so. In the same table it is shown that three animals in the "Japanese Cane Lot" lost in weight and two gained, while in "Corn Fodder Lot," three gained, and the remaining two maintained their weight.

TABLE VII.—EXPERIMENT V.—*Summary record of weights and feed given.*

		Lot I. Japanese cane lot.	Lot II. Corn fodder lot.
1.	Number of days of experiment	26	26
2.	Number of animals	5	5
3. (*a*)	Total initial wt. of the animals, January 6, 1919, *Kg.*	1929.12	1920.59
(*b*)	Total average wt. of the animals, January 6, 1919, *Kg.*	385.82	384.12
4. (*a*)	Total final wt. of the animals, January 31, 1919, *Kg.*	1917.75	1935.74
(*b*)	Total average final wt. of the animals, January 31, 1919, *Kg.*	383.55	387.15
5. (*a*)	Gain or loss, *Kg.*	—11.37	+15.15
(*b*)	Average gain or loss, *Kg.*	—2.27	+3.03
6. (*a*)	Total feed consumed, *Kg.*	2853.19	3826.39
(*b*)	Average feed consumed, *Kg.*	570.64	765.28
7. (*a*)	Total possible days worked	77	77
(*b*)	Average days work per animal	15.4	15.4

Table VII shows that the "Japanese Cane Lot" consumed 2853.19 kilograms of feed with an average consumption of 570.64 kilograms, and lost 11.37 kilograms in weight. The "Corn Fodder Lot" consumed 3826.39 kilograms and gained 15.15 kilograms in weight. Corn fodder gave the better results, therefore.

TABLE VIII.—*Summary of results.*

Experiments.	Lot No.	Feed.	No. of animals.	Total feed consumed.	No. of days of experiment.	Total possible days worked.	Gain or loss.
				Kg.			*Kg.*
1-A. Aug. 25 to Oct. 19, 1917	1	Corn + Pasture	5	262.24 *a*	56	99	—20.04
	2	Pasture alone	5	——		99	—20.20
1-B. Oct. 20 to Dec. 14, 1917	1	Pasture alone	5	——	56	96	—86.4
	2	Corn + Pasture	5	211.46 *a*		96	—42.1
1-C. Dec. 15, 1917 to Jan. 14, 1918	1	Pasture alone	5	——	30	54	+25.32
	2	Corn + Pasture	5	170.00 *a*		54	+16.45
II. March 16 to April 26, 1918	1	Sugar cane tops + Pasture.	5	612.15	42	88	+14.7
	2	Corn fodder + Pasture	5	1190.71		88	+25.5
III. Aug. 17 to Sept. 28, 1918	1	Guinea grass + Pasture	4	944.8	42	88	+22.3
	2	Corn fodder + Pasture	4	1314.9		88	—1.9
IV. Nov. 9 to Dec. 14, 1918	1	Japanese cane + Pasture	5	498.3	35	75	—26.6
	2	Corn fodder + Pasture	5	1245.8		75	+31.6
V. Jan. 6 to Jan. 31, 1919	1	Japanese cane	5	2853.19	26	77	—2.29
	2	Corn fodder	5	3826.39		77	+5.05

a Grain.

SUMMARY

1. Under the conditions of the present tests, feeding unshelled corn in quantities, which shelled, would vary from two to three and five-tenths kilograms a day, to work bullocks of about 375 kilograms in weight, as a supplement to native pasture, did not prove to be of special advantage. (The bullocks were fed only when scheduled to work.) It is possible that the slight differences obtained in favor of the corn-fed lot were due to short pasture, and that the animals without any supplement feed did not get full feed.

2. Of sugar cane and corn fodder used as supplements to native pasture, corn fodder proved to be the better. This difference was due mainly to the comparative softness of the corn fodder; the animal was able to consume enough of it to make a full meal. Sugar cane tops, though palatable, were so hard that the animals were unable to consume large enough quantities to make a full feed.

3. Of Guinea grass and corn fodder used as supplements to native pastures, Guinea grass proved to be slightly the better.

4. Of Japanese cane (using the whole plant) and corn fodder as supplements to native pastures, corn fodder proved to be the better. Gains were observed in the "Corn Fodder Lot," while slight losses were recorded in the "Japanese Cane Lot."

5. When Japanese cane was fed exclusively for 26 days to one lot of animals and corn fodder to another lot, both lots registered slight gains. The feeds proved about equal, the small differences being in favor of the "Corn Fodder Lot."

RECOMMENDATIONS

1. When pasture forage is abundant and succulent and when the animals are given sufficient time to eat and rest, native pastures need not be supplemented.

2. Work animals when used for hard work should be given supplementary feeds in addition to the native pastures if the time allowed in the latter be short. Such feeds may be corn fodder, Guinea grass, or sugar cane tops. The kind of fodder to be used will be determined principally by the seasons. Corn fodder is preferable, as it gives a larger yield of available feed. Japanese sugar cane should

be reserved for the dry season, as it is a crop that remains standing green and succulent during the dry season.

3. Corn grown for forage should be planted rather close. This develops finer and smaller stalked plants, softer in texture, with few or no ears, and with the nutrient better distributed throughout the body of the plant.

ACKNOWLEDGMENT

The writer wishes to express here his obligations to Associate Professor B. M. Gonzalez for his valuable suggestions and criticisms during the progress of the experiments, and to Mr. Jose P. Esguerra, Assistant in Animal Husbandry, for practical advice and for help in weighing the animals.

"Art in general consists of the truths of science, arranged in the most convenient order for practice, instead of the order which is most convenient for thought."—J. S. MILL.

SELECTION IN SOY BEANS [1]

By Felix Noroña Maceda

When and by whom the soy bean was introduced into the Philippines is not known. It has long been in cultivation in the Islands, but has never been considered as a crop worthy of attention. In the future it should be a crop of importance throughout the Archipelago: it can be grown and handled without difficulty; the yield of seed is large; as a food for human beings and for animals it is excellent; and the oil and meal made from the seeds find a ready market at a good price. In the Philippines, the soy bean is used in the manufacture of soy bean curd (tahure), soy bean sauce (toyo) and such minor food articles as soy bean cheese and soy bean milk. The manufacture of these products is in most cases carried on by the Chinese.

In Japan and China, the soy bean plant takes a prominent place in general farming. It has been in cultivation in China for 5,000 years. In Japan the plant is highly valued as a nitrogen gatherer and is extensively grown in rotation with cereals. Its value in fixing nitrogen in the soil is very high. Besides such economic uses as cited above, bread and biscuits prepared from soy beans are found in the European markets. Roasted soy beans are used for adulterating coffee and cacao. The oil extracted from the bean is used as a lubricant and for making soap. In China the oil is also used for illuminating purposes (2). Although limited in use in the Philippines, soy beans play an important part in the industries of other countries, notably Japan and China where the yearly production of soy sauce, alone, amounts to nearly 2,000,000 barrels (1). The value of soy bean oil, alone, imported from China and Japan into the United States from 1910 to 1917 was 11,000,000 dollars. The importance of legumes as a source of protein food for man is becoming generally recognized. Because of the richness in nutrients of soy beans and the comparatively low cost of production of the crop, it should take a high rank among our legumes, and be utilized more generally throughout the Islands as a staple food substitute for meat (2).

The present work, which is a continuation of Layosa's thesis (3), has for its objects:

1. The multiplication of strains selected by Layosa and the running of plant-to-row tests of the most productive individuals or elites of each strain.
2. The isolation of strains that can be recommended for the rainy season and strains for the dry season under local conditions.
3. The comparison of the yield of selected strains with that of unselected plants.

The isolated strains for the rainy season and those for the dry season were selected from the most productive individuals of the preceding cultures. The strains from the rainy season crop will be designated in this article as "rainy season seeds" and the strains of the dry season cultures, as "dry season seeds."

The seeds from Layosa's work were found to be divided into "rainy" and

[1] Thesis presented for graduation from the College of Agriculture, No. 103; Experiment Station contribution, No. 21.

"dry" season seeds. Because of scarcity of labor, only the seed from the most productive individuals in his strains were selected and planted.

For both the rainy and the dry season cultures, the writer used the Amis bean variety bearing the College Number 217. The seeds were in their F_6 and F_7 generations. Of the rainy season seeds, Layosa gave to the Department of Agronomy four strains of elites, nineteen of the multiplication, and some common stock material. For the dry season, he had only fourteen strains of multiplication and some common stock seeds. The following is a brief outline of the cultures carried out:

RAINY SEASON

Amis variety. Elite.
Planted June 5, 1918.
$217F_5$.
Strains 2 (N7), 4 (N8), 4 (N9), and 5 (N10)

MULTIPLICATION

Planted June 12, 1918.
$217F_8$.
Strains 2 (P210-N2), 6 (P210-N6), 12 (P210-N38), and 14 (210-N27).

COMMON STOCK

Planted June 24, 1918.
$217F_8$..... 1 Plot.

DRY SEASON

MULTIPLICATION

Planted October 31, 1918.
$217F_7$.
Strains 2 (P7-N1), 3 (P7-N2), 10 (P80-N17), 12 (P80-N19), 14 (P80-N21), 20 (P100-N5), 26 (P108-N17), and 29 (P107-N7).
$217F_8$.
Strains 26 (P40-N33), 27 (P138-N13), 28 (138-N14).

COMMON STOCK

Planted November 2, 1918.
$217F_7$.....1 Plot.

EXPERIMENTS

RAINY SEASON CULTURE

The rainy season culture was planted in a field that had been planted previously to corn. The field covers an area of 3,550 square meters. The land was plowed in the early part of the rainy season and disc-harrowed once to break the big clods, to destroy weeds, and to produce a soil mulch. Because the land had been previously planted to corn only one plowing and one harrowing were required to make it ready for planting. The seeds were planted 50 centimeters by 70 centimeters. The distance between the rows was made 70 centimeters, so as to allow cultivation with a bullock. In all the rainy season plantings only one plant was grown in each hill. The planting was done by hand, from three to six seeds being dropped into each hill. After complete germination the plants in each hill were thinned to one. The corn driller was tried for soy beans, but it was found that too many seeds dropped at irregular intervals, so its use was not continued. The seeds were planted immediately after the land was prepared. All of the plantings in this culture were cultivated with a bullock three times and were weeded once before harvest.

Conditions were very favorable for the rainy season cultures. Seven days after the seeds were planted there was a rain that gave the young seedlings a good

start; and thereafter there were occasional rains. The hard winds about the first week of July did no damage, as the plants were strong enough at this period to resist them.

DRY SEASON CULTURE

The field used for this planting had been planted previously to peanuts. It covers an area of 3,136 square meters and is located at the extreme south end of the new citrus plantation. The land was plowed and harrowed once and planted to soy beans immediately. As in the rainy season culture, the hills were 50 centimeters by 70 centimeters apart. After complete germination the plants were thinned to one to a hill. The seeds were dropped in furrows 50 centimeters apart, then covered five centimeters deep with soil. To hasten germination the soil was pressed down with the foot. This planting was cultivated with a bullock four times before harvest. The dry season culture was subjected to very adverse conditions, because drought prevailed throughout the progress of this part of the work. Since the land was very dry at planting, germination was very poor.

HARVESTING

The age at which to harvest the soy bean is determined by the use for which the crop is intended. If the plants are intended for forage, the best time to harvest is when the pods are just forming. It is at this age that the plants are most palatable and digestible (2). If intended for hay the soy bean plants should be cut when the pods are about half-filled, and dried and handled the same as pea-vine hay. Wianko and Fisher of the Agricultural Experiment Station of Purdue University do not recommend the soy bean for hay-making; they regard it as distinctively a grain crop. The change in color of the pods from green to brownish yellow or light brown is considered a safe indication of maturity. At this time the crop needs to be watched and harvested before the pods are thoroughly ripe, lest many of them burst open and the seeds be scattered. As a general rule it is recommended that the soy bean should be harvested as soon as three fourths of the leaves have fallen and when the majority of the pods have attained a brownish color. The cutting should be done at a time of the day when the pods are slightly moist, so they will not burst open (3).

In this work the plants were cut with a bolo and gathered in small piles sufficiently large to handle and to dry easily.

THRESHING

When thoroughly dried the beans were threshed out by beating and were put in sacks. They were then sifted and winnowed. When used with certain precautions, the bean and pea huller was found useful.

CURING

After the seeds were cleaned of foreign matter, they were dried in the sun for a period of from five to six hours, cooled, and placed in sacks or bags in storage. Well-cured seeds are not so likely to be attacked by beetles as are seeds that are not properly cured.

RESULTS AND DISCUSSION

TABLE I—*Élite cultures of Amis Beans (217F_5), during rainy season; planted June 5, 1918, harvested November 6, 1918.*

Pedigree number.	Parents.				Progeny.					
	Number of plants.	Total weight of plants.	Weight of seeds.	Computed yield per ha.	Number of plants.	Weight of plants.	Weight of seeds.	Computed yield per ha.	Computed gain or loss over parent.	Computed gain over common stock.
		kg.	*kg.*	*kg.*		*kg.*	*kg.*	*kg.*	*kg.*	*kg.*
2 (N7)	52	1.52	0.92	471.73	89	3.47	3.75	1192.8	721.1	880.4
3 (N8)	35	1.06	0.66	426.27	191	5.73	8.85	1278.0	851.7	965.6
4 (N9)	44	2.20	0.93	563.47	51	2.55	2.00	1107.6	544.1	795.2
5 (N10)	24	0.71	0.41	455.46	95	1.95	2.00	606.4	150.9	294.0
Common stock				239.99				312.4		

As a conclusion based on computed yield, we find from Table I, that all the four strains tested gave a higher yield in beans than their respective parents. They also surpassed the yield of the common stock. Strain 2(N7) gave a yield of 1278.00 kilograms per hectare. This was 721.07 kilograms more than the parent, and 880.40 kilograms more than the common stock. Strain 3(N8) gave the highest yield, 1192.80 kilograms per hectare. This was 851.7 kilograms more than the parent, and 965.60 kilograms more than the common stock. Strain 4(N9) yielded 1107.6 kilograms per hectare. This was 544.1 kilograms more than the parent, and 795.20 kilograms more than the common stock. Strain 5(N10) produced 606.04 kilograms per hectare. This was 150.94 kilograms more than the parent, and 294.0 kilograms more than the common stock. The common stock of this year also proved superior to Layosa's.

The yield in dry forage was 1050.80 kilograms per hectare. This dry forage consisted mostly of stems, for the leaves had all shattered before the weight was taken.

Table II shows the results obtained from the multiplication plots. These results show that each of the four superior strains in Layosa's culture tested by the writer gave a higher yield than either parent or common stock. Strain 6(P210-N6) gave 994.00 kilograms per hectare, the highest yield. This was 790.27 kilograms more than the parent and 793.00 kilograms more than the common stock. Next in yield came strain 14(P210-N27) giving a yield of 624.00 kilograms per hectare. This was 422.4 kilograms more than the parent and 423 kilograms more than the common stock. Strain 12(P210-N38) yielded 596.4 kilograms per hectare. This was 402.54 kilograms more than the parent and 395.4 kilograms more than the common stock. Strain 2(P210-N2) gave a yield of 448.8 kilograms per hectare. This was 281.33 kilograms more than the parent and 247.8 kilograms more than the common stock. It is to be noted that the common stock this season proved superior to two of the parents tested. These particular cases may be explained by the adaptability of the strain to the surrounding conditions.

As to dry forage only 803.6 kilograms were obtained per hectare. This is a lower yield than Layosa's and was caused by the shattering of the leaves.

Regarding the dry season cultures, eight of the most productive strains from Layosa's seeds gave very low yields. This culture was cultivated four times with a bullock, and large weeds were removed from near the plants. After three months

TABLE II.—*Multiplication cultures of Amis Beans (217 F_8), during rainy season.*

PARENTS.					PROGENY.								
Pedigree number.	Number of plants.	Total weight of plants.	Weight of seeds.	Computed yield per ha.	Date planted.	Date harvested.	Number of plants.	Total weight of plants.	Weight of seeds.	Computed yield per ha.	Computed gain or loss over parent.	Computed gain or loss over common stock.	Pct. Inc. of offspring over common stock.
		kg.	*kg.*	*kg.*				*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	
2(P210-N2)	261	8.0	1.64	167 47	June 12, 1918	Nov. 9, 1918	1535	46.05	27.09	448.8	281.33	247.8	55
6 (P210-N6)	212	7.2	1.62	203.73	June 12, 1918	Nov. 9, 1918	617	18.51	21.72	994.0	790.27	793.0	79
12 (P210-N38)	205	7.8	1.49	193.86	June 12, 1918	Nov. 9, 1918	841	25.23	18.40	596.4	402.54	395.4	66
14 (P210-N27)	432	17.0	3.27	201.60	June 12, 1918	Nov. 12, 1918	562	15.86	12.74	624.0	422.40	423.0	68
Common stock				125.33	June 12, 1918	Nov. 12, 1918				20.10			

TABLE III.—*Multiplication cultures of Amis Bean (217 F_6 and F_7), during dry season.*

PARENTS.					PROGENY.								
Pedigree number.	Number of plants.	Total weight of plants.	Weight of seeds.	Computed yield per ha.	Date planted.	Date harvested.	Number of plants.	Total weight of plants.	Total weight of seeds.	Computed yield per ha.	Computed gain or loss over parents.	Computed gain or loss over common stock.	Pct. Inc. of offspring over common stock.
		kg.	*kg.*	*kg.*				*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	
2 (P7-N1)	515	7.6	3.92	202.66	Oct. 21, 1918	Feb. 26, 1919	187	1.44	2.56	511.2	308.54	277.8	54
3 (P7-N2)	465	8.8	4.35	247.99	Oct. 21, 1918	Feb. 26, 1919	191	2.29	2.53	369.2	121.21	135.8	37
10 (P80-N17)	694	13.0	6.37	243.35	Oct. 21, 1918	Feb. 26, 1919	201	2.41	2.17	284.0	40.65	50.6	18
12 (P80-N12)	410	14.0	7.81	407.95	Oct. 21, 1918	Feb. 29, 1919	275	3.30	3.85	397.6	— 10.35	164.2	41
14 (P80-N21)	360	12.8	6.64	291.72	Oct. 21, 1918	Feb. 29, 1919	189	2.26	2.46	69.2	—122.52	164.2	-237
20 (P80-N5)	223	13.0	4.66	557.07	Oct. 21, 1918	Feb. 29, 1919	125	1.50	1.61	340.0	—217.07	106.6	31
26 (P108-N17)	254	13.2	6.96	730.67	Oct. 21, 1918	Feb. 27, 1919	182	2.18	1.85	284.0	—446.67	50.6	18
29 (P107-N7)	250	5.6	7.90	766.93	Oct. 21, 1918	Feb. 27, 1919	200	2.40	2.46	340.8	—426.13	107.4	31
26 (P138-N33)	414	16.8	2.97	191.19	Oct. 21, 1918	Feb. 27, 1919	215	2.58	1.08	142.0	— 49.19	—91.4	—64
27 (P138-N13)	403	9.6	7.96	535.55	Oct. 21, 1918	Feb. 28, 1919	300	3.60	3.92	369.2	—166.35	135.8	36
28 (P138-N14)	330	11.3	7.09	751.46	Oct. 21, 1918	Feb. 28, 1919	322	3.86	5.55	482.4	—269.06	149.0	31
Common stock										233.4			

and eleven days the plants were ready to be harvested. But, according to the man in charge of the work during the writer's absence in the National Guard, they were harvested late because of a scarcity of labor. At the harvesting time the leaves had already all fallen off, so the pulling up of the plants was comparatively easy. It appears probable that the low yields obtained in this culture, in most cases, were caused by the delay in harvesting. It seems safe to estimate the loss because of this to be as high as 25 per cent.

From Table III we find that out of the eleven strains tested only three gave better yields than their respective parents. Strain 2(P7-N1) gave a yield of 511.20 kilograms per hectare. This was 308.54 kilograms more than the parent and 277.8 kilograms more than the common stock. Strain 3(P7-N2) produced 369.2 kilograms per hectare. This was 121.21 kilograms more than the parent and 135.8 kilograms more than the common stock. Strain 10(P80-N17) yielded 284 kilograms per hectare. This was 40.65 kilograms more than the parent and 50.6 kilograms more than the common stock. All of the other strains gave lower yields than their parents. The writer's common stock was inferior in yield to Layosa's.

The amount of forage obtained was considerably lower than that of the rainy season culture, because the plants were very dry at harvest. The weight of dried forage, amounting to 340.71 kilograms per hectare, was lower than that of the rainy season culture.

CONCLUSIONS

1. All the rainy and some of the dry season strains that were multiplied in this work gave higher yields than their respective parents. The increase in yield should not be attributed to the effect of selection, since each set of offspring and their parents belong to the same line. It should be considered as a result of more favorable environmental conditions, and as an effect of acclimatization. This result emphasizes the necessity in any work of this kind of the use of check, or control plots.

2. As a result of this work, four strains selected by Layosa have been planted in "plant-to-row" cultures, thus providing materials for subsequent multiplication. A similar number of strains have been multiplied under rainy season conditions, and eleven under dry season conditions. The total amount of harvested material from the multiplication cultures will provide commercial seed for not less than 20 hectares.

3. The strains for the rainy and the dry season cultures may be recommended as rainy or as dry season seeds, for both cultures have already undergone some degree of acclimatization.

4. With two exceptions, all selected strains grown in this work gave higher yields than the common stock, thus showing the advantage to be derived from selection. The gain in percentages of the yield of the selected strains over the common sort ranges, in multiplication plantings, from 18 per cent to 79 per cent.

ACKNOWLEDGMENT

The writer wishes to express his thanks to Associate Professor Inocencio Elayda for his help and suggestions during the early part of the work. Appreciation is also due Mr. Rufino Isidro, Student Assistant in Agronomy, who took charge of the work while the writer was in the Philippine National Guard.

BIBLIOGRAPHY

(1) WILLIAMS, THOMAS A. The soy bean as a forage crop. U. S. Dept. Agriculture Bulletin 58; 3.

(2) MORSE, W. J. The soy bean industry in the United States. U. S. Dept. Agric. Yearbook **1917**: 101-111. 1918.

(3) LAYOSA, PEDRO MAKALINDONG. Field tests of soy beans. Philippine Agriculturist **10**: 226-286. 1918.

(4) GAPUS, G. and BOISE, D. Les soya. Les produits coloniaux. Paris, France. pp. 115-117. 1912.

(5) HENDERSON, PETER. The use of the foot in planting. Gardening for profit. pp. 96-98. New York, 1897.

(6) MOORE, R. A. Experiments with grains and forage plants. B. Test for forage plants. Soy beans. Twentieth Annual Report Wisconsin Agric. Exp. Sta. pp. 271-274. 1904.

(7) WIANKE, A. T. and FISHER, M. L. Soy beans and cowpeas. Purdue Univ. Agric. Exp. Sta. Bull. 120: 439-451. 1907.

"A science teaches us to know, and an art to do, and all the more perfect sciences lead to the creation of corresponding useful arts. The sciences of mathematics, physics, chemistry, botany, and zoology, etc., form the basis of the arts of agriculture, horticulture, forestry, floriculture, animal husbandry, etc."

COLLEGE AND ALUMNI NOTES

The College year started on June 6 with an enrollment of 445 students.

The College of Veterinary Science opened on July 1, on the campus of the College of Agriculture. The veterinarians are occupying temporarily the Tobacco House and one wing of the new Pathology-Entomology laboratory building. Work has already begun upon a permanent building for them. At present the first and second years of the course are given at Los Baños, while the last three are given in Manila. Dean C. F. Baker is acting as dean of the College of Veterinary Science.

Dr. Rafael B. Espino has reported for duty as instructor in Crop Physiology, after a two year period as a pensionado in the United States. He left the College in June, 1917, and after a few months at the University of Chicago, he went to Johns Hopkins University, where he worked as a graduate student under the direction of Professor B. E. Livingston and received his doctor's degree in June, 1919.

Governor Carpenter of Department of Mindanao-Sulu has just requested, through the President of the University, to be assigned ten graduates from this College to manage ranches and breeding work in Mindanao. The day has come when the value of the College of Agriculture in the agricultural development of the Islands is beginning to be realized. Governor Carpenter has compared the work done by untrained men with that done by men trained in science at this College, and he speaks emphatically in favor of the trained men.

Mr. Eugene May, of the section of crop physiology in the U. S. Department of Agriculture, spent the months of September and October working on the citrus plants at the College. The U. S. Department of Agriculture has a plantation on the College Farm containing about 1,000 varieties of citrus. Work is being done especially on problems connected with breeding and resistance to citrus canker. This work is under the direction of Mr. W. T. Swingle of the U. S. Department of Agriculture. Mr. Swingle visited the College about a year ago.

In addition to the University pensionados mentioned in the editorial in this issue, a number of other students from the College of Agriculture are now attending universities in the United States. Faustino Q. Otanes, '18, has been appointed pensionado from the Bureau of Agriculture and is studying economic entomology at the University of Illinois. Domingo B. Paguirigan, has been appointed pensionado from the Bureau of Agriculture, to study tobacco culture in the United States. Silvestre Asunción, '12, has been sent as a pensionado from the Bureau of Agriculture to specialize in agronomy. Another Bureau of Agriculture pensionado, Jose Q. Dacanay, '15, is studying agricultural statistics and journalism in the University of Illinois. The former students, Sabino Ami and Doroteo M. Flores, are pensionados from the Bureau of Education. Nicanor G. Teodoro, '15, is a pensionado at Wisconsin University studying plant pathology; he has been sent by the Bureau of Agriculture. Besides these pensionados, several students have gone at their own expense to the United

States; among these are Leopoldo S. Clemente, '17, who is specializing in animal breeding at the University of Illinois; Felipe T. Adriano, '19, who is studying chemistry at Columbia University; Segundo Labayen, '15, studying sugar chemistry at Louisiana University; Felix D. Maramba, studying mechanical engineering and agriculture at the University of Illinois; Tomas Rigor, studying agriculture at the University of California; and Jose M. Leuterio, studying agriculture at Washington State College.

The residence of Dr. and Mrs. Roxas was the scene of a delightful reception and dance given on June 26, in honor of the departing pensionados of the College. All the members of the faculty and their wives were present. The guests also included the Misses Villegas, Yñiguez, and Pantua of Los Baños, and graduate assistants Quisumbing, Luistro, and Panganiban. The affair was greatly enjoyed. Bountiful refreshments were served and the Calamba Orchestra furnished music throughout the evening.

The Commander of the army post at Camp Eldridge, Los Baños, has requested the co-operation of the College in connection with the proposed vocational training for the men of the U. S. Army. Professors Elayda and Gonzalez have been designated by the Dean to co-operate on the agronomy and the animal husbandry projects, respectively.

Mr. Pedro A. David, '19, won the prize of ₱150 offered by the Bureau of Internal Revenue for the best paper on tobacco. The title of this paper is *The Tobacco Seedbed.*[1]

The Board of Regents recently appropriated money for the construction of several temporary houses for student dormitories on the College Campus. Even when these are built there will be accommodations for only about one-fourth of the total number of students attending the College.

Steps have been taken by the Department of Agriculture and Natural Resources towards the establishment of the Laguna Poultry-Swine Station on the College Campus; the management of this station would be entrusted to the Animal Husbandry Department of the College.

Professor B. M. Gonzalez reports the gestation of three carabao cows as being 318, 324, and 324-328 days; observations in the United States show that the period is 280 days for the common cow and 340 days for the horse.

The first "At Home Day" of the Student Body this year took place on August 13. The entertainment consisted of music and addresses. The talks were interesting, instructive, and witty. An address was made by Professor Evett D. Hester on "Economic advancement under American Administration," and one was made by Dr. Rafael B. Espino on his "Experiences in the United States."

Mr. Gonzalo F. Marino, '14, chief of the pest control section of the Bureau of Agriculture, sailed for Japan to study pest control methods used in that country.

Mr. Melecio M. Manio, '19, is now in the employ of the Department of Mindanao and Sulu. He is stationed at Dansalan, in Lanao Province, and is working, under the direction of Mr. Silayan, '16, on the cultivation of upland rice. Besides the rice project, both Mr. Silayan and Mr. Manio are engaged in planting coffee, and propagating and cultivating Irish potatoes.

1 David, Pedro, The tobacco seedbed. Philippine Agricultural Review 12: 31-65. *Pl. 7-16.* 1919.

Mr. Emilio Africa, '18, resigned his position as agricultural superintendent of the San Ramon Penal Colony at Zamboanga to accept the position as manager of a coconut plantation in Cotabato province owned by Unson and Company of Lucena, Tayabas.

Mr. Felix Maceda, '19, is now working in the central office of the Bureau of Agriculture.

Mr. Eduardo Quisumbing, '18, graduate assistant in plant physiology, has been appointed secretary of the College of Agriculture Alumni Association.

Mr. Gofulpo Teodorico, '15, has registered in College for post-graduate work in sugar chemistry. He has been appointed as an assistant in Plant Breeding.

The Seniors at the College went out on two successive Saturdays, September 6 and 13, and hauled a massive three-ton rock from the Molawin Creek. They intend to carve on this rock the names of the members of the class of 1920 and to leave it as a class memorial.

On October 25, the Senior Class of the Manila High School visited the College. They came by special train and spent the day inspecting the work at the College. A dance was given in the new laboratory building and many of the students of the College attended. Luncheon was served in the student mess.

On October 11, National Guard Day was celebrated in the College. There was a military parade in which students who had been in the National Guard participated. This was followed by a musical program in the Auditorium. Also, an address was given by Professor Gonzales on patriotism and the significance of the National Guard Day. In the afternoon there was an interprovincial athletic meet.

Mr. Valente Villegas, '13, was married to Miss Manuela Kalaw on June 8, 1919. The bride is a sister of Mrs. Manuel Roxas, Secretary Kalaw, and Professor Maximo Kalaw. The marriage ceremony took place in the Lipa Church. A reception at the home of the bride followed the ceremony.

Mr. Victor Sulit, '19, was married to Miss Catalina Napiza in August. The home of both is Santa Cruz, the capital of Laguna Province. The marriage ceremony was performed in the Aglipay Church, Santa Cruz.

Word has been received recently that Mr. Valentin Erese, '19, was married to Miss Crecencia Tampoco of Tarlac; the marriage took place in Manila.

On August 12 a banquet was given by the "Pampangueños" of the College in honor of Mr. Valentin Erese and his bride, and Mr. Pedro David, '19, Assistant in agronomy. Despite the heavy rain on that evening the guests met at the appointed hour at the Ideal Restaurant in Los Baños. They report a delightful time.

Dr. and Mrs. Forman T. McLean and their young son John visited China and Japan during the past summer vacation, leaving Manila on March 28. They first visited the botanical gardens in Hongkong where they met Mr. Tutcher, the Superintendent, and Dr. Kammerling, of the Buitenzorg Botanical Gardens. From Hongkong they went to Canton where they spent three weeks at the home of Professor Groff, of the Canton Christian College. Several excursions were made in company with Professor Groff and Mr. Levine to neighboring farms and orchards. From Canton the McLeans went to Yokohama. At Tokyo, a visit

to the Agricultural College of the Imperial University proved very valuable. The buildings and grounds are well arranged, and the teaching staff is most courteous and apparently competent and well-trained. The classes are conducted in Japanese, but all of the teaching force have some speaking knowledge of English. They have at the College only about 60 acres of land, and do practically no field experimenting there. A brief trip was made to Nikko, then from Yokohama to Kyoto, and from there to Nagasaki. The Japanese formal gardens of Kyoto are specially noteworthy. The Nagasaki Noji Shikenjo (Agricultural Experiment Station) is carrying on experiments in culture of rice, barley, wheat, sweet potatoes, and fruit trees under the supervision of Director Shino and Dr. Miki. Arrangements were made for exchange of plants with Director Shino, who is especially anxious to secure varieties of sweet potatoes from the Philippines. Mr. H. A. Lee, of the U. S. Department of Agriculture, is conducting experiments in the control of citrus canker at Saigo near Nagasaki and he hopes to duplicate in Japan the excellent results obtained at the College of Agriculture and at Lamao. The McLeans returned to Manila on June 12. On July 3, Mrs. McLean and John sailed for the United States. They expect to return at the opening of the next College year.

Introducing our new line of
HARDWARE

HAMMERS
SAWS
PLIERS
NAILS, Assorted
WIRE, Etc.

Also Lanterns, Folding Cots, Oil Cloth, Blankets, Radiolite Watches, and Other Accessories for Camping

WE ARE HERE TO SERVE YOU

COLLEGE CO-OPERATIVE CO., INC.